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DRIVE FOR COLD PILGER ROLLING STAND

SPECIFICATION

FIELD OF THE INVENTION

The present invention relates to a drive for a cold pilger rolling stand. More particularly this invention concerns such a drive that reciprocates the roller bearing on the hollow advancing workpiece.

BACKGROUND OF THE INVENTION

In cold pilger rolling a hollow billet is advanced in a r lling direction over a generally stationary mandrel while a pair of rolls squeeze the billet against the mandrel to form seamless pipe or tubing. The support or stand carrying these rolls is reciprocated through a short stroke in and against the rolling direction, often at high speeds up to 300 strokes/minute.

The common stand or support in which the rolls are journaled is reciprocated in the rolling direction by means of a crank drive. A tie rod has an outer end journaled on the reciprocal roll stand and an inner end eccentrically mounted on a crank arm or wheel that is continuously rotated at the desired stand reciprocati n speed. Since the amount f throw is

23644

c nsiderable, it is standard to provide counterweights to reduce vibration and strain on the machinery.

Thus, as described in US patent 5,540,076 based on German 4,336,422 of Baensch and Bonsels, each of two crank arms connected to opposite sides of the roll stand carries a respective counterweight and a common drive motor is connected through respective identical gear trains to the cranks. This is a very large and complex mechanism that is very expensive to build and maintain, and that takes up a great deal of space.

German patent 962,062 of Zeunert employs a vertically effective counterweight. This system requires the base for the roll stand to be very expensively and massively built, as it must accept the vertically moving parts. A big below-ground area must be provided for the drive mechanism.

In German patent 3,613,036, US patent 5,858,458, and US patent 5,076,088 another system is described using planetary type crank drives for compensating out the forces in such a pilger rolling system. Such systems are highly effective, but only work with relatively small systems forming small-bore thin-wall tubing. The machinery becomes extremely large and unwieldy when applied to large rolling stands.

In all the known pilger cold-rolling systems there is the disadvantage that the throw-canceling systems are quite complex and expensive.

22644

OBJECTS OF THE INVENTION

It is therefore an object of the present invention to provide an improved drive for a pilger cold-rolling stand.

Another object is the provision of such an improved drive for a pilger cold-rolling stand which overcomes the above-given disadvantages, that is which is simple and relatively inexpensive.

SUMMARY OF THE INVENTION

A drive for reciprocating a roll stand of a pilger cold-rolling system has according to the invention a crank rotatable about an axis transverse to a reciprocation direction f the stand and a tie rod having an outer and journaled on the stand and an inner end eccentrically journaled on the crank so that rotation of the crank reciprocates the stand in the direction. A compensating weight is fixed to the crank opposite the tie rod and orbits in a weight plane on rotation of the crank. A counterweight is offset along the weight plane from the crank. A drive connects the counterweight to the crank for orbiting the counterweight in the weight plane on rotation of the crank.

Such a drive system is extremely simple, yet operates with minimal vibrati n and throw.

22644

The pilger roll-stand drive according to the invention has respective shafts carrying the compensating weight and counterweight. The drive includes respective meshing gears fixed to the shafts. A drive shaft carries a gear meshing with the gear of the shaft carrying the counterweight. This drive shaft is the output shaft of a motor or a transmission connected to a motor. The shafts are rotatable about axes that are all coplanar and parallel. Hence all the forces are in a line and basically cancel one another out.

According to a further feature of the invention the stand is centered on the weight plane. In addition the crank can be centered on the weight plane. In the former system the crive has a second crank coaxial with and connected to the first-mentioned crank, a second tie rod having an outer end journaled on the stand and an inner end eccentrically journaled on the second crank, a second compensating weight fixed to the second crank opposite the tie rod and orbiting in a second weight plane parallel to but offset from the first-mentioned weight plane on rotation of the cranks, and a second counterweight offset along the second weight plane from the second crank. The drive also connects the second counterweight to the second crank for rbiting the second counterweight in the second weight plane on rotation of the second crank.

In another system according to the invention the roll stand is c nt red n a plane symmetrically flanked by the first

22644

and second weight planes. The drive can be offset from the planes.

According to another feature of this invention the gears are unitarily formed with the respective weights. The shafts can be horizontal or vertical.

The crank in accordance with the invention has a pin on which the inner end of the tie rod is journaled and that is formed with passages through which a lubricant can be fed.

The masses of the compensating weight(s) and of the counterweight(s) is selected such that they compensate for the first-order stand mass forces during operation of the rolling stand. Such a system is extremely simple. It can be set up and manufactured according to straightforward design practices and very accurately compensates out the vibration and throw produced by the reciprocating roll stand and associated drive parts. The result is virtually no vibration so that the equipment is not hard on its support and surroundings. Its service life will therefore be quite long.

22644

BRIEF DESCRIPTION OF THE DRAWING

The above and other objects, features, and advantages will become more readily apparent from the following description, it being understood that any feature described with reference to one embodiment of the invention can be used where possible with any other embodiment and that reference numerals or letters not specifically mentioned with reference to one figure but identical t those of another refer to structure that is functionally if not structurally identical. In the accompanying drawing:

FIGS. 1a and 1b are schematic side views illustrating a pilger rolling system;

FIGS. 2a and 2b are side and top sectional views through a first drive according to the invention;

FIGS. 3a and 3b are views like FIGS. 2a and 2b through a second drive in accordance with the invention;

FIGS. 4a and 4b are views like FIGS. 2a and 2b through a third drive; and

FIGS. 5a and 5b are views like FIGS. 2a and 2b through a fourth drive according to the invention.

22644

SPECIFIC DESCRIPTION

As seen in FIGS. 1a and 1b a tubular workpiece, here a billet 22, is advanced in a horizontal rolling direction R over a mandrel 24 centered on an axis A of a rolling system 1. Two rolls 23 rotatable about parallel horizontal axes 23A lying in a plane perpendicular to the axis A and parallel direction R are carried in a common frame or stand 2 (FIGS. 2a and 2b) reciprocated in and against the direction R. Thus as the rollers 23 are reciprocated in the direction R by a crank assembly 4 (FIGS. 2a and 2b) their rotation directions change as indicated by the unreferenced arrows.

FIG. 2 shows how two parts of the stand 2 symmetrically flank a plane 15 extending parallel to the direction R and axis A and are interconnected by a pivot pin 18 on which is journaled an outer end of a tie or thrust rod 7 whose inner end is journaled on an eccentric pivot pin 19 carried on a crank 5 on a shaft 13 journaled in a stationary housing 3 and carrying a compensating weight 6. This shaft 13 also carries, diametrically opposite the pin 18, a counterweight 8.

Two further shafts 12 and 14 are journaled in the housing 3 and centered on axes lying on a horizontal plane 25 with the axis of the shaft 13. The shafts 12, 13, and 14 carry meshing gears 9, 10 and 11 and the shaft 14 is connected to an electric drive motor 28. Another counterweight 8 is carried on the shaft 12 at its end opposite the respective gear 10. The two

22644

weights 6 and 8 are centered and lie on a common vertical plane 26 parallel to the plane 15.

Thus as the motor 28 rotates the shaft 14, the shaft 12 and counterweight 8 rotate oppositely to the shaft 14 and the shaft 13 and compensating weight 6 codirectionally to it. Rotation of the shaft 13 causes the pin 19 to orbit about the axis of the shaft 13 and thereby reciprocate the stand 2 horizontally.

With this system therefore the compensating weight 6 and the counterweight 8 are set up such that the first-order mass f rces for the system are formed by the roll stand 2 are compensated out by the compensating weight 6 and counterweight 8. Mass forces of second and higher order, which are created by the reciprocation of the stand 2, are not compensated out. Nothing need be done to compensate for the moment that is perpendicular to the horizontal reciprocation direction R of the stand 1 and the perpendicular forces from the weights 6 and 8. The same is true for the other moments because the inertia of the weights 6 and 8 are not aligned to the inertia of the stand 2.

The suggested drive concept thus has somewhat less mass compensation as the solutions of the prior art. This disadvantage is not important on small installations, since the amplitudes of the forces and moments transmitted to the base are small. Only in the case of installations with particularly vibration-sensitive bases are del teri us ff cts noticed in the surroundings. In this case however the analytical s lutions f

the known systems and if necessary further compensations are necessary.

The solution of FIGS. 2a and 2b with a single thrust rod 7 is particularly effective. The entire crank assembly 4 is aligned with the center plane 15 of the roll stand 2 so that the system is generally horizontally level with this equipment.

In order to supply lubricant to a bearing 27 between the pin 19 and the inner end of the rod 7, the pin 19 is formed with an axial passage 20 and a radial passage 21. Thus lubricant can be fed through these passages 20 and 21 to this bearing 27 even while the machine is operating. A similar system can be provided for the unillustrated bearing on the pivot pin 18. In this manner the lubricant oil can be kept completely separate from any coolant that is used.

The system of FIGS. 3a and 3b has a pair of thrust rods 7 and 7' symmetrically flanking the roll-stand plane 15 and connected to opposite ends of a pin 19' projecting from opposite ends of a crank wheel 5 that is integrally formed with the compensating weight 6. Here the crank wheel 5 actually forms the gear 9, the gear 10 is formed with the counterweight 8, and the g ars 10 and 11 are all centered on the plane 26 which is coplanar with the plane 5. The gears 9, 10, and 11 are slightly below the path of the strand moving in direction R.

In FIGS. 4a and 4b there are two crank assemblies 4 and 4' symmetrically flanking the plane 26 and each having respective compensating weights 6 and 6' and counterweights 8 and 8'. The

22644

drive assembly constituted by the gears 9, 10, and 11 is offset to one side of the crank assembly 4. Thus the symmetrically arranged weights 6, 6', 8, and 8' completely compensate out the forces on the central plane 15.

FIGS. 5a and 5b show an arrangement identical to that f FIGS. 2a and 2b except that the plane 26 is horizontal and the shafts 12, 13, and 14 are vertical.